General comments

1. This paper describes a data product for patches of fire occurrence across the world from 1984 to near present using Landsat images. It's an ambitious effort given the challenges of data volume and the heterogeneity in challenges that must be overcome to map fires across the entire earth. After some thought, and after reading the first reviewer's comments, I am not as down on the data product as reviewer number 1, but I do think it is perhaps better characterized as a beta version 0.5, rather than a full-on 1.0. I'll try not to be redundant with the first reviewer here, although I agree with much of what they say.

Responses:

We sincerely thank the reviewer for the thoughtful and constructive comments, which helped us substantially improve both the framing and transparency of the manuscript. We appreciate the reviewer's recognition of both the ambition and the technical challenges associated with generating a global multi-decadal Landsat-based fire patch dataset.

We agree that the original manuscript did not sufficiently clarify the scope, intended applications, and limitations of the current product, which may have led to an overly strong impression regarding its maturity and completeness. In the revised manuscript, we have substantially revised the positioning and presentation of the dataset to better reflect its current strengths and limitations.

Specifically, we now emphasize that the product is designed primarily as a spatially explicit characterization of forest fire patch patterns, rather than as a complete global burned area inventory or a fully resolved fire event reconstruction product. We have also expanded the discussion of methodological limitations, uncertainty sources, forest mask assumptions, temporal aggregation choices, and data usability considerations.

In addition, throughout the manuscript, we have clarified the intended application scenarios of the dataset, particularly for regional ecological analyses, fire patch morphology studies, and landscape-scale spatial fire pattern characterization in regions where Landsat observations provide reliable coverage.

2. Reviewer 1 rightly pointed out the lack of agreement in tropical regions as their reasoning behind their opinion that Landsat is simply not an appropriate product for mapping burned area globally. I'm not sure I would go that far. The thing that actually gave me both hope and concern was lack of agreement between the GlobMap FFP and the BAECV in the US. From my own experience I've found the BEACV to be quite good, at least in the study areas in which I have used it. So why is this product not matching the BAECV? To me, if this algorithm were calibrated so that it can at least match the performance of well-validated reference data (BAECV or even to something human-verified like MTBS perimeters in the US), maybe we could at least feel confident that this product is capturing what Landsat can legitimately detect in the tropical areas where there is generally much less human-verified reference data. So I guess my takeaway is not that Landsat cannot capture burned area well in the tropics, rather that this particular product is doing a bad job in most places, so maybe a better product could.

Responses:

We thank the reviewer for this insightful comment, which highlights important differences in agreement among burned area products across well-studied regions.

We agree that discrepancies observed in the United States are particularly informative because several well-established reference datasets are available in this region. We also agree that evaluating agreement against products such as BAECV and MTBS provides valuable context for understanding the capabilities and limitations of Landsat-based fire mapping approaches.

Our additional examination suggests that differences between GlobMap FFP, BAECV, and MTBS should not necessarily be interpreted as evidence that one product is correct and another is incorrect. Rather, they largely reflect differences in mapping objectives, temporal attribution strategies, and operational definitions of burned area. Specifically, BAECV is based on pixel-level spectral change detection and may exhibit sensitivity to persistent post-fire spectral anomalies following high-severity fires. In such cases, persistent post-fire spectral signals may be represented differently depending on the temporal attribution and compositing strategy adopted by each product, contributing to differences in mapped burned area (**Figure R1 and Figure R2**). Meanwhile, MTBS provides fire perimeters derived from manual interpretation of Landsat imagery and auxiliary information. While MTBS is widely used as a reference dataset, its polygon-based representation necessarily generalizes fine-scale heterogeneity within fire perimeters, potentially including unburned or partially burned regions within mapped boundaries (**Figure R3**). This characteristic may lead to systematic differences in estimated burned area compared to pixel-based products, particularly in heterogeneous fire events.

Our product, in comparison, is designed to provide a globally consistent characterization of forest fire patches based on Landsat spectral trajectories, with annual temporal attribution intended to reduce repeated representation of persistent post-fire signals across multiple years. lies in its spatially explicit representation of long-term fire patch patterns and geometry, rather than in reproducing any single existing burned area product. We have revised the manuscript to clarify these conceptual differences and to emphasize that agreement with reference datasets should be interpreted in the context of their respective mapping definitions and methodological assumptions.

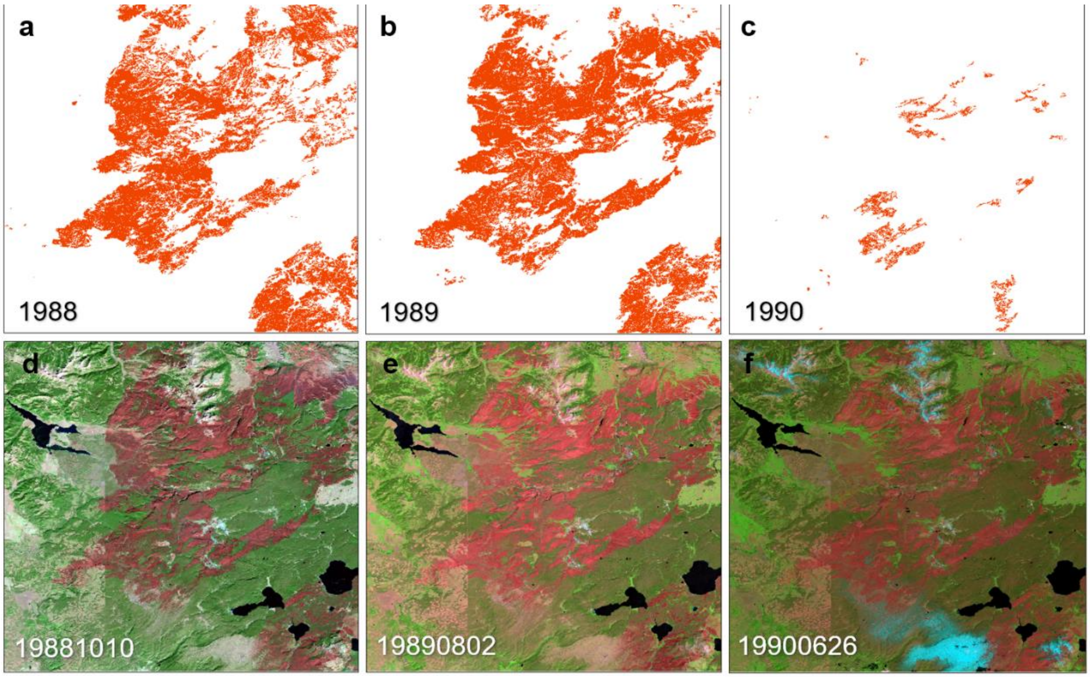

Figure R1. BAECV example of the 1988 fire at the Yellowstone National Park. a-c show the detected burned area in BAECV in 1988, 1989 (one year after burning), and 1990 (two years after burning), respectively. **d-f** show the false-color composites of Landsat imagery in the corresponding years.

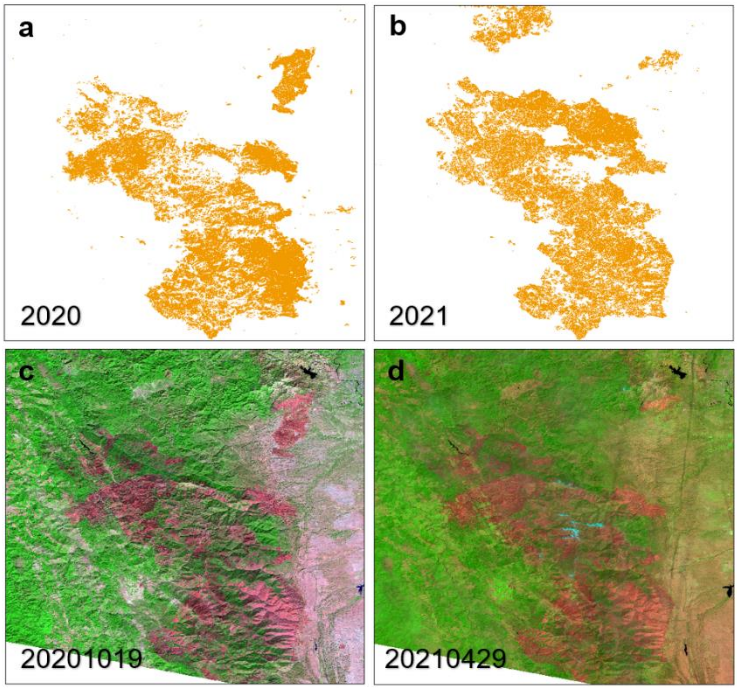

Figure R2. BAECV example of the 2020 fire in Northern California. a and **b** show the detected burned area in BAECV in 2020 and 2021 (one year after burning), respectively. **c** and **d** show the false-color composites of Landsat imagery in the corresponding years.

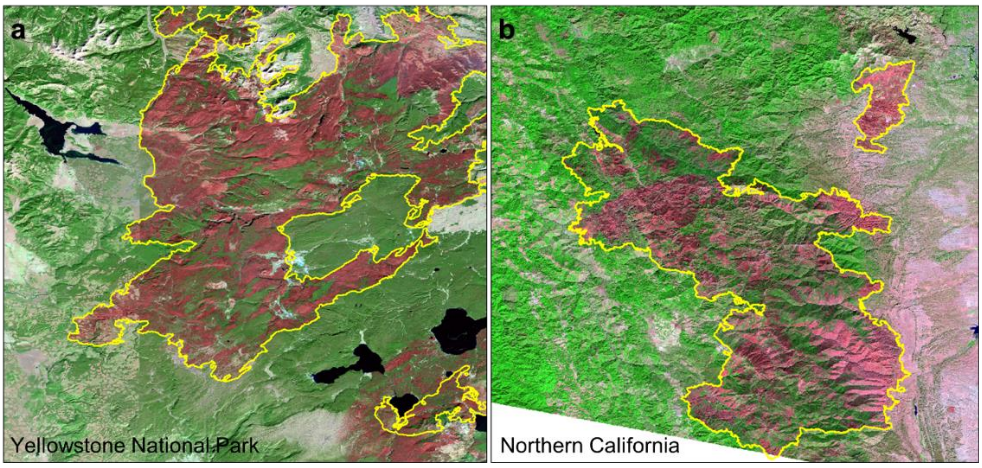

Figure R3. MTBS examples of the (a) 1988 fires in Yellowstone National Park and the (b) 2020 fires in Northern California.

3. My other major concern is the packaging of the data product. It is provided as each individual Landsat tile zipped up as a geotiff (666 zipped files for each 5 year time period), which has a fairly high barrier to convenient use. it would make a lot of sense to polygonize the individual fire events and provide regional shapefiles they way other products do. The rasters do not provide heterogeneous values within each event (for example, burn severity), so having each pixel is of limited utility compared to polygons with scar ID and date as attributes. One first step might be to polygonize the whole time series for each landsat tile and go from there. Even if there are concerns with the errors of omission, if it were actually convenient to use, it might still be useful to many people. Especially in ecological studies at regional scales in places where the algorithm did a good job.

Response:

We thank the reviewer for this valuable suggestion regarding the usability and packaging of the dataset. We agree that vectorized fire patch products can substantially improve convenience for ecological and regional-scale applications, particularly for users interested in fire geometry and patch-level analyses.

In the current version, we chose to distribute the dataset in raster format primarily to preserve the original 30 m spatial detail and within-patch heterogeneity represented in the Landsat-derived fire maps. Raster representation also avoids potential geometric simplification introduced during large-scale polygonization and provides greater flexibility for users interested in pixel-level spatial analyses and customized post-processing workflows. In addition, polygonization at the global scale over the full multi-decadal archive would generate extremely large and computationally complex vector datasets, particularly for fragmented and spatially heterogeneous fire patches. Therefore, the current release prioritizes scalable raster-based storage and analysis.

We acknowledge, however, that vectorized products improve accessibility and usability for many regional ecological applications. To facilitate this, the dataset includes unique fire patch identifiers that allow users to perform customized polygonization according to their specific study objectives and regional requirements.

We have clarified this design rationale and the potential for future vectorized products in **Lines 550 – 552** of the **Data availability** as below:

"*The dataset is distributed in raster format to preserve pixel-level spatial heterogeneity; future versions may explore polygon-based representations for improved usability.*"

We have also modified the related sentences in **Lines 93 – 96** of the **Introduction** as:

"*The final product is distributed in raster format, with each fire patch assigned a unique identifier together with associated attributes including burned year and quality assurance (QA) information. This raster-based representation preserves fine-scale spatial heterogeneity while supporting analyses of fire patch morphology, spatial organization, and long-term forest fire dynamics.*"

Specific comments:

1. 97, Figure 5: The 25% cutoff for forest cover might be a little high. If I am interpreting figure 5 correctly, this cutoff value is excluding essentially all forests in the western US, for example. I think there needs to be a figure right up front that shows the land area that meets the filtering criteria and is considered 'forested'. In Figure 5b, for example, it is not clear whether 0 fire occurences is a different color than unanalyzed non-forested regions. I'd suggest grey for 0 fires and white for unanalyzed.

Response:

We thank the reviewer for this helpful suggestion. We agree that the forest-cover threshold and the visualization of analyzed versus non-analyzed regions should be clarified more explicitly in the manuscript.

The 25% tree-cover threshold was adopted as a commonly adopted operational definition (Hansen et al., 2013; Harris et al., 2012; Myroniuk et al., 2020) to provide a globally consistent forest mask and to reduce contamination from sparsely vegetated or non-forest fire-prone areas. However, we acknowledge that this threshold may exclude some open-canopy forest and woodland systems, particularly in regions such as the western United States.

Following the reviewer's suggestion, we have added a new map in **Figure 5** (showing as **Figure R4** below) showing the global spatial extent of regions that meet the forest filtering criteria and were included in the analysis to improve clarity. We have also revised **Figure 5** to clearly distinguish between areas with 0 detected fire occurrences and non-analyzed non-forest regions. non-analyzed regions are now shown in white, whereas analyzed regions with zero fire occurrences are displayed in grey.

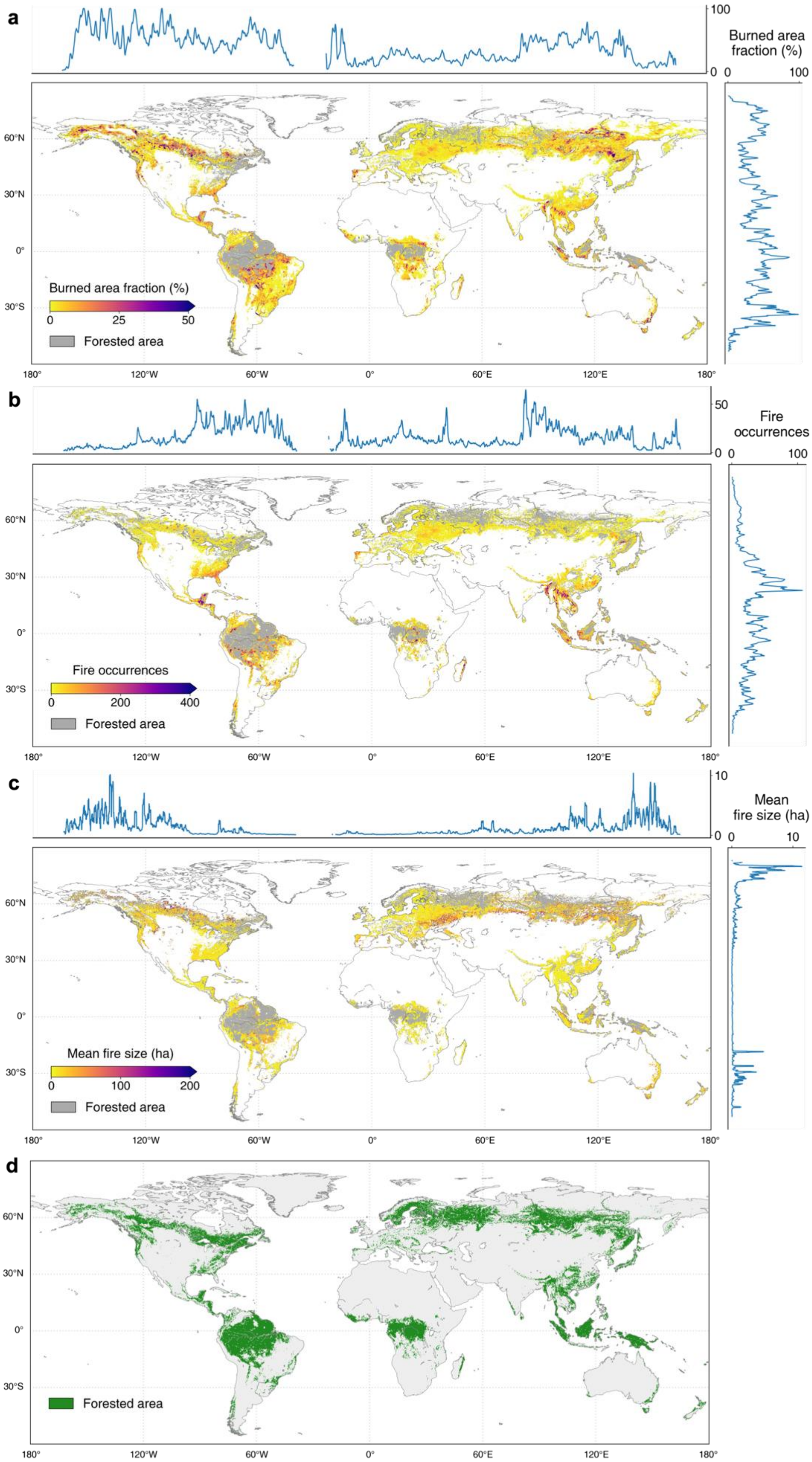

Figure R4. Spatial distributions of total global forest fires over 1984 – 2022 based on the dataset developed in this study. (a) Burned area fraction (%), (b) fire occurrences, (c) mean fire size (ha). (d) shows the identified forested area. The variables were aggregated at a 0.1° resolution for data visualization.

We have also clarified the forest-mask definition and its implications in **Lines 117 – 120** of the **Datasets**:

"*This operational threshold is commonly used in global forest mapping studies to distinguish forest from non-forest land cover types on satellite data (Myroniuk et al., 2020; Hansen et al., 2013; Harris et al., 2012). While it improves global consistency in forest delineation, it may exclude some sparsely wooded systems, particularly in dry forest–savanna transition regions such as parts of western North America.*"

References:

Harris, N. L., Brown, S., Hagen, S. C., Saatchi, S. S., Petrova, S., Salas, W., Hansen, M. C., Potapov, P. V. & Lotsch, A. (2012). Baseline Map of Carbon Emissions from Deforestation in Tropical Regions. Science ***336****, 1573-1576.*

Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A., Tyukavina, A., Thau, D., Stehman, S. V., Goetz, S. J., Loveland, T. R. et al. (2013). High-Resolution Global Maps of 21st-Century Forest Cover Change. Science ***342****, 850-854.*

Myroniuk, V., Kutia, M., J. Sarkissian, A., Bilous, A. & Liu, S. (2020). Regional-Scale Forest Mapping over Fragmented Landscapes Using Global Forest Products and Landsat Time Series Classification. Remote Sensing ***12****, 187.*

2. Please do some kind of formatting with the reference section to make them easier to look through (number them, have some indentation on the left side, whatever is in accordance with the publication's style)

Response:

We have increased the spacing after each reference and added a hanging indent to improve readability.

3. 142-151: Please provide the brown vegetation index as an equation as this is not as commonly used for fire as the normalized burn ratio (NBR). Why was this used instead of NBR and how is it different?

Response:

We thank the reviewer for this important comment. We agree that the NBR is one of the most widely used indices for burned area mapping. The objective of adopting BVI in this study was not to replace NBR as a general burned area index, but to improve the burn-signal consistency within our multi-year Landsat compositing framework. Compared with NBR, which relies on the contrast between NIR and SWIR2 reflectance and is highly sensitive to vegetation structural changes, BVI emphasizes the contrast between green and SWIR2 reflectance. Because NIR generally exhibits stronger and more rapid post-fire recovery responses than visible wavelengths (Pérez-Cabello et al., 2021; McKenna et al., 2018), NBR-based signals may attenuate more rapidly in composited imagery, particularly in regions with sparse observations or rapid vegetation regrowth. In comparison, the green-SWIR2 contrast used in BVI was considered advantageous for preserving persistent burn darkening signals in composited imagery under heterogeneous observation conditions. Additionally, BVI was selected partly because cloud, snow, and aerosol contamination generally increase BVI values, making them less likely to be retained in minimum-value composites.

We have revised the manuscript to clarify that BVI was selected to improve the consistency and persistence of burn-signal characterization in the compositing step, rather than to imply universal superiority over NBR. We have added the equation of BVI and modified the following sentences in **Lines 177 – 188** of the **Methods** as below:

"*Previous compositing approaches commonly relied on minimum NBR, NDVI, or NIR values (Chuvieco et al., 2005; Miettinen and Liew, 2008; Barbosa et al., 1998; Alencar et al., 2022). However, NIR-based burn signals often recover rapidly after fire, which can reduce their persistence in long-term composites, particularly in regions with sparse observations or rapid vegetation regrowth (Mckenna et al., 2018; Pérez-Cabello et al., 2021). By contrast, the green-SWIR2 contrast captured by BVI tends to preserve burn-darkening signals for longer periods and is less sensitive to cloud, shadow, and aerosol contamination during minimum-value compositing (Liu, 2017). BVI is calculated as:*

$$BVI = \frac{\rho_{Green} - \rho_{SWIR2}}{\rho_{Green} + \rho_{SWIR2}},$$

where ρ_{Green} and ρ_{SWIR2} represent surface reflectance in the green and SWIR at 2.1 µm (SWIR2) wavelengths, respectively. BVI exploits the contrasting spectral responses of burned surface in the green and SWIR2 bands. Following fire disturbance, SWIR2 reflectance typically increases because of vegetation moisture reduction and charcoal deposition, whereas green reflectance decreases with vegetation damage (Chuvieco et al., 2019; Liu, 2017), producing characteristically low BVI values over burned area."

We have also added the following sentence in **Lines 516 – 518** of the **Discussion**:

"*Future work should evaluate how different compositing strategies influence fire patch reconstruction across contrasting fire regimes and compare the performance of BVI-based and NBR-based approaches under varying environmental conditions.*"

References:

Pérez-Cabello, F., Montorio, R., & Alves, D. B. (2021). Remote sensing techniques to assess post-fire vegetation recovery. Current Opinion in Environmental Science & Health, 21, 100251.

McKenna, P., Phinn, S., & Erskine, P. D. (2018). Fire Severity and Vegetation Recovery on Mine Site Rehabilitation Using WorldView-3 Imagery. Fire, 1(2), 22.

4. 186: maybe give this distance in meters (600m).

Response:

We have added the distance in meters in the manuscript.

5. 186: Same year is almost certainly too broad of a time range. Many other products have used same month, or even 5-15 days. Products using those tighter temporal windows also included grasslands, but still, considering the global scope, many forested areas with year-round growing seasons (e.g. SE United States) have been observed to burn multiple times in the same year.

Response:

We appreciate the reviewer's important comment regarding the temporal aggregation window used to define fire patches. We agree that annual aggregation is not appropriate for studies focused on fire-event chronology, ignition timing, or short-interval reburning. The adopted temporal framework reflects a deliberate trade-off aimed at reconstructing long-term fire patch structure from heterogeneous Landsat observations at the global scale.

Compared with shorter temporal windows, annual compositing can help preserve the spatial coherence and complete burned scar extent of large fires, particularly for fires that span multiple months, which is common in boreal and temperate forests). This enables analyses of fire patch geometry, size distribution, and landscape-scale fire heterogeneity that are difficult to achieve using temporally fragmented monthly fire products.

Another consideration is the availability of cloud- and snow-free Landsat observations. In many regions globally, particularly in high latitudes, humid tropical regions, and mountainous areas, clear observations are often only available at intervals of several months (Feng and Wang, 2024; Flores-Anderson et al., 2023). As a result, consistent monthly-scale compositing of fire patches with Landsat remains challenging at a global scale.

Given these constraints, a yearly temporal window was adopted as a pragmatic compromise to ensure global consistency in mapping burned scar extent while maximizing spatial coverage and completeness. This design prioritizes the reconstruction of spatially continuous burn scars rather than resolving within-season fire chronology.

We acknowledge that multiple fire occurrences within a single year may be merged in regions with repeated burning. However, because the primary objective of the dataset is to characterize the spatial structure and geometry of fire patches, the annual aggregation framework remains suitable for the intended applications of GlobMap FFP. This issue is likely to be most relevant in regions characterized by frequent reburning within a year, such as parts of the southeastern United States and some tropical fire-prone landscapes.

We have modified the writing in **Lines 223 – 232** of the **Methods** to clarify this rationale:

"*Burned area pixels detected within the same burned year and separated by less than 20 Landsat pixels (600 m) were grouped as a single fire patch and assigned a unique fire identifier. The objective of this procedure was to generate spatially coherent fire patches suitable for fire regime analyses at a global scale rather than to reconstruct individual ignition events. This distance threshold was selected to bridge small unburned gaps commonly caused by heterogeneous fire spread, cloud contamination, or omission errors in burned area detection while avoiding excessive merging of spatially independent fires. Temporal segmentation was* *based on annual burned year assignments rather than sub-annual fire chronology, because the heterogeneous availability of cloud- and snow-free Landsat observations limits reliable global-scale reconstruction of fire timing (Feng and Wang, 2024; Flores-Anderson et al., 2023). As a consequence, multiple fires occurring within the same year and in close spatial proximity may be represented as a single fire patch, potentially overestimating patch sizes and underestimating fire occurrences.*"

We have added the following sentences in **Lines 473 – 478** of the **Discussion**:

"*Because the availability of cloud- and snow-free Landsat observations varies substantially across regions and time periods, GlobMap FFP focuses on reconstructing the spatial characteristics of fire patches rather than resolving detailed within-season fire chronology to achieve global consistency. The adopted multi-year compositing strategy therefore represents a pragmatic trade-off between global consistency, temporal precision, burned scar completeness, and computational efficiency. Although this design inevitably sacrifices some temporal precision, it enables a globally consistent reconstruction of long-term fire patch patterns from the heterogeneous Landsat archive.*"

We have also discussed the limitation of our methods in **Lines 508 – 516**:

"*Additional differences arise from the methodological choices adopted to achieve globally consistent fire patch reconstruction. The multi-year compositing strategy reduces the influence of cloud contamination, data gaps, and uneven observation availability while maintaining computational feasibility. Yet, because only a single observation is retained for each pixel within a compositing interval, repeated burning occurring at the same location during the same interval are not explicitly reconstructed. Fire recurrence may be underrepresented in frequently burned regions, and fire occurrence frequencies derived from the dataset should be interpreted with caution. Furthermore, the annual aggregation may merge temporally adjacent fires into a single fire patch, likely resulting in overestimated patch sizes and underestimated fire frequencies. Consequently, GlobMap FFP should be interpreted as a spatially explicit fire patch dataset rather than a complete inventory of all forest burned area, particularly in frequently burned tropical forests.*"

References:

Feng, L., & Wang, X. (2024). Quantifying Cloud-Free Observations from Landsat Missions: Implications for Water Environment Analysis. Journal of Remote Sensing, 4, 0110.

Flores-Anderson, A. I., Cardille, J., Azad, K., Cherrington, E., Zhang, Y., & Wilson, S. (2023). Spatial and Temporal Availability of Cloud-free Optical Observations in the Tropics to Monitor Deforestation. Scientific Data, 10(1), 550.